NISAC

Water Infrastructure Simulation Environment

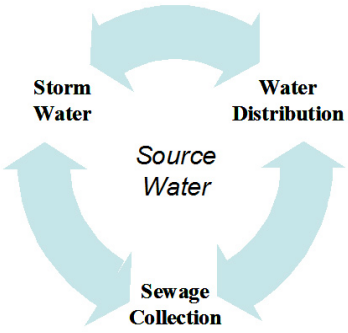
The National Infrastructure Simulation and Analysis Center (NISAC) provides advanced modeling and simulation capabilities for the analysis of critical infrastructures, their interdependencies, vulnerabilities, and complexities. These capabilities help improve the robustness of our nation's critical infrastructures by aiding decision makers in the areas of policy analysis, investment and mitigation planning, education and training, and near real-time assistance to crisis response organizations.

The Department of Homeland Security's (DHS) Information Analysis and Infrastructure Protection (IAIP) Directorate sponsors the NISAC program. NISAC is a core partnership of Los Alamos National Laboratory (LANL) and Sandia National Laboratories (SNL). NISAC integrates the two laboratories' existing expertise in modeling and simulation to address the nation's potential vulnerabilities and the consequence of disruption among our critical infrastructures.

Water Infrastructure Interdependencies

Water is the lifeblood of society. Not only is potable water a necessity for human health, water is also used in fire protection, waste conveyance, electricity generation, industrial processes, irrigation, as well as a multitude of other uses. For these reasons, complex sets of infrastructures have been developed to adapt natural hydrology to the benefit of humanity. These infrastructures are capable of controlling water at its source, importing and distributing water to human settlements, treating and dispersing the subsequent significant quantity of waste ridden water, and addressing the impacts of the modification of the natural hydrologic cycle on other infrastructures. Loss of one or many of these capabilities can significantly impact human health and socioeconomic well being, and the maintenance and protection of water infrastructure is therefore critical to the economic and social health of the United States. Water infrastructures are a complex system of systems that can be divided into three components:

1. **Water distribution:** supply, treatment, and distribution of potable water for human consumption, waste conveyance, fire protection supply, and industrial/commercial uses.
2. **Sewage Collection:** collection, treatment, and disposal of wastewater.
3. **Stormwater:** collection, treatment, and disposal of stormwater runoff.
4.

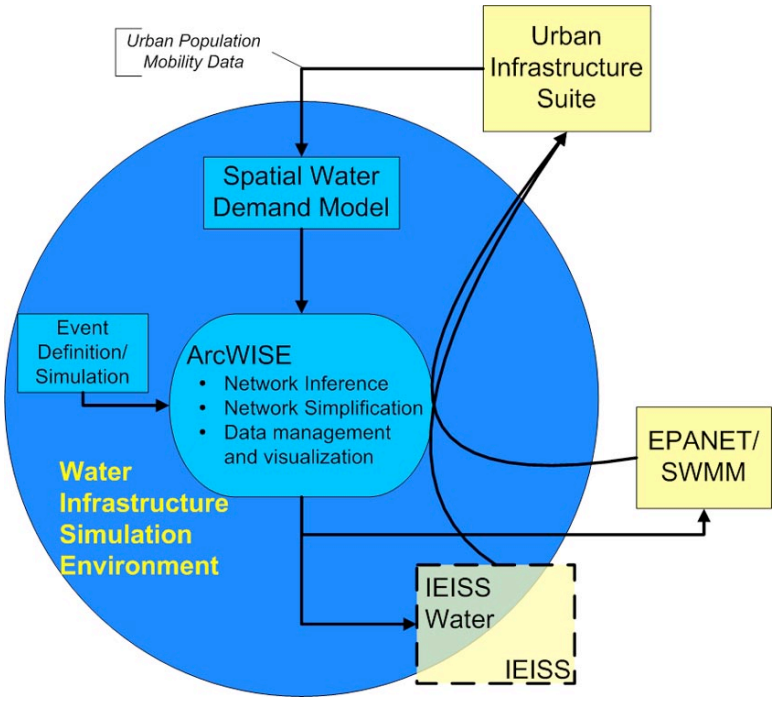


Each of these infrastructures is inexorably linked with the others. Water distribution systems are the primary source for water in the wastewater collection system; storm sewer systems can feed into the sanitary sewer system; potable water from the municipal drinking water system enters the storm drain system as nuisance flows; and discharged treated wastewater and storm water can enter a surface water body that subsequently may be used as an urban water supply. The planning, design, operation, and maintenance of these water infrastructures has typically considered them as autonomous units. This approach has led to the development of world class water infrastructure in the United States, but protection of these critical infrastructures requires an understanding of the interdependencies between

water infrastructures and other critical infrastructures. The existing modeling and simulation technology base has a single infrastructure focus and does not account for interdependencies. Therefore, application of these tools may hinder protection of these infrastructures. Los Alamos National Laboratory has an extensive history of success studying infrastructure interdependencies as well as other complex nonlinear systems in support of the United States national security. These prodigious capabilities are being adapted to the study of water infrastructure interdependencies.

WISE

The Water Infrastructure Simulation Environment (WISE) is an analytic framework supporting the evaluation of water infrastructure in terms of both infrastructure specific and interdependency issues. WISE involves the integration of geographic information systems with a wide range of infrastructure analysis tools including industry standard hydraulic simulation engines (e.g., EPANET and SWMM) as well as Los Alamos National Laboratory interdependency simulation systems such the Urban Infrastructure Suite (UIS) and the Interdependent Energy Infrastructure Simulation System (IEISS). Key components in the WISE framework are ArcWISE, a GIS based graphical user interface, and IEISS Water, a water infrastructure interdependency simulation capability within IEISS. ArcWISE leverages the existing data management, analysis and display capabilities within geographic information systems while also extending them to infer, improve and amend water infrastructure data in support of running hydraulic simulation engines such as EPANET or IEISS Water. ArcWISE also provides tools for defining and simulating infrastructure damage events, such as a fire, and generating water demand/sewage production estimates. IEISS Water is an extension of the IEISS analysis software to water distribution infrastructure simulation. Like other hydraulic simulation engines, IEISS Water provides the ability to simulate the physical behavior of water infrastructures, but more importantly IEISS Water accounts for the nonlinear dynamics within and between water infrastructures as wells as other critical infrastructures. IEISS Water provides capabilities to identify critical components, define system vulnerabilities, simulate scenarios, screen possible interdependency contingencies, and define service areas and outage areas. These infrastructure interdependency capabilities are a significant advance over most water infrastructure simulation systems making IEISS Water an important tool for homeland security.



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